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## ALTERNATING CURRENTS.

*Alternating Currents: a Text-book for Students of Engineering.* By C. G. Lamb. Pp. vi+325. (London: Edward Arnold, n.d.) Price 10s. 6d. net.

THIS book is designed to be a text-book for students of engineering, more particularly for those who are going through a course at the engineering laboratory at Cambridge. In any attempt to write an account of alternating currents for such a purpose, the question arises at once, Out of all the materials at the disposal of the author, what should be selected as being most suitable, or on what principle should such a selection be made? The answer to this question may perhaps be best given by considering the requirements of engineering students. Chiefly, perhaps, the mind must be trained to accurate thought; but, apart from this, which is common to all scientific education, a student should acquire a thorough knowledge of fundamental principles in such a way that he may have confidence in himself when he is faced with the various problems that constantly arise in the course of his professional career. Beyond this, he should be taught sufficient of the methods of procedure in common use, so that when he takes up his first appointment in a subordinate position he will be able to follow with intelligence the methods of practice used by his superiors. As Mr. Lamb remarks in his preface, details of actual practice are unsuitable in such a book, and are best learned by actual contact with drawing-office work.

If the book in question be examined in the light of these principles, it will be seen that the statements of the fundamental ideas are very clear, and are logically followed up. It might, perhaps, be suggested that there is a tendency to explain various actions by means of equations rather than by physical conceptions. One is somewhat reminded of the mathematical coach lecturing on optics, who introduced the subject of optical instruments with the remark that a telescope is defined by the equation  $K=0$ . Many students are naturally inclined to view physical problems in this way, and such a tendency should be checked, especially among intending engineers.

With regard to the methods of procedure in common use, it cannot be said that this book is irreproachable. In particular, practically no mention is made of the necessity of designing apparatus to meet a given temperature specification. This necessity makes itself felt throughout almost the entire range of electrical apparatus, and yet with the exception of one brief paragraph the subject of temperature rise is not mentioned. A student reading this book with no other source of information at his disposal might be excused for imagining that apparatus was usually designed without any definite ideas as to its capacity, and was only rated after it had been manufactured and tested to see what it would stand. This must be regarded as an unfortunate omission.

Turning now to the consideration of the book in detail, it should be remarked that a certain extent of previous acquaintance with elementary theory is

assumed, chiefly the theory of magnetism, including hysteresis and eddy currents, and a knowledge of vectors. The author has not attempted to introduce any symbolic treatment, no doubt very wisely.

The first seven chapters cover the preliminary statements of the usual methods of treating alternate-current problems in general, also of measuring instruments, and discuss the theory of the single-phase transformer. This piece of apparatus is regarded first of all in the light of a choking coil, for which the fundamental vector diagrams are obtained. Following this the analytical expressions for an actual transformer are worked out, and methods are described whereby the regulation can be calculated. The fifth chapter concludes with a paragraph giving a few constants for a modern type, which might have been more valuable if some indication had been given as to how such constants vary over a range of transformers for different outputs and frequencies, and with different load factors. Special types of transformer occupy the sixth chapter, in which mention might have been made of sucking—or booster—transformers, to be quite up to date; while the seventh chapter is devoted to efficiencies.

Apart from the points mentioned, which are not important, the foregoing chapters may be said to be excellent both in matter and in manner. Unfortunately, the same cannot be said of the very brief mention of single-phase commutator motors which occupies the eighth chapter. This part gives one the impression of having been put in as an afterthought; neither the repulsion motor nor the compensated repulsion motor is mentioned, and the type of series motor illustrated is already antiquated; moreover, the self-induction of the whole motor cannot be reduced to that of the field coils alone (p. 95).

The rest of the book is devoted to the consideration of alternators both as generators and motors, and of induction motors. Without following the treatment too closely, it may be remarked that wave forms are considered with reference to the presence of harmonics, the properties of concentrated and distributed windings are set out, and towards the end of the book armature reaction is considered in detail.

The treatment of the latter subject is based chiefly on the method of synchronous reactance, in which the whole reaction is considered simply as due to a single internal self-induction. This method has several drawbacks, and for practical work it is better to look upon the action of the armature as partly a demagnetising effect and partly a self-induction. This treatment is very simple, and sufficiently accurate if proper constants are taken. In chapter xxi. of Mr. Lamb's work the armature reaction is dealt with in greater detail, and is split up into three components, viz. stray field reactance, cross and back reactances, each of which has its own magnitude and its own phase. It is stated that this method leads to very good results, but it is more cumbersome, and seems to contain as much liability to error as the method above alluded to.

Space will not permit of more than a brief reference to many of the subjects dealt with. Induction motors are discussed with reference to the well-known Hey-

land circle diagram, and emphasis is laid on the necessity for proper phase relations being maintained between the applied voltages. A short chapter is devoted to induction meters, the principles of which are explained analytically and graphically.

Compound alternators are referred to somewhat scantily, only two types being described, both of which are manufactured by the Westinghouse Company. The parallel running of alternators is examined by the aid of synchronous reactance, and various methods of synchronising such machines are described.

The operation of synchronous motors is treated in the same way at considerable length, and an interesting graphical method is given for finding the value of the motor E.M.F. for any given load, due, we understand, to Mr. G. T. Bennett, of Emmanuel College, Cambridge. There is a short reference to the hunting of such motors, and to the action of the amortisseur. The book concludes with a chapter on the rotary converter, with special paragraphs on the E.M.F. relations, current relations and ohmic loss, starting, pressure regulation, efficiency and hunting.

It may be remarked that no mention whatever is made of transmission lines, a subject which would naturally be included in a book such as this; but possibly the author may have adequate reasons for the omission.

Apart from criticism of the contents of the book, it is necessary to direct attention to one point referred to in the preface, viz. the question of references to previous writers whose works have been requisitioned. It is quite true that such references are not of great value to the student, and would be unnecessary for others if no original matter were introduced. This, however, is not the case, and it is unreasonable to assume that the learned persons, mentioned by Mr. Lamb, who read the book will be acquainted with the authorship of this original matter. The number of engineers who are practically familiar with all branches of alternating-current science must be very small, and anyone wishing to study a particular branch from Mr. Lamb's book would naturally ascribe to him the credit for some of the original matter contained therein. In a few places, contributions have been abstracted from the proceedings of learned societies without a word of acknowledgment. Rather than adopt such a course it would be better to adhere to the system in vogue in Germany, where a man who writes a book on any subject without supplying with it a complete bibliography is considered a hopeless amateur.

#### THE CELL AND HEREDITY.

*Die stofflichen Grundlagen der Vererbung im organischen Reich. Versuch einer gemeinverständlichen Darstellung von Eduard Strasburger. Pp. viii+68. (Jena: Gustav Fischer, 1905.) Price 2 marks.*

THIS little sketch of the cell as the bearer of the hereditary qualities of the organism is full of interest, like everything that springs from Prof. Strasburger's pen. It is written in somewhat popular

style, but is nevertheless a thoughtful and real contribution to the literature of the subject.

The book opens with a brief but sufficient account of the processes associated with the formation of the sexual elements, and with the outlines of nuclear division in so far as they are necessary for the understanding of the main problem.

The author follows current opinion in laying great stress on the qualitatively equal division of the chromosome secured by the mode of longitudinal fission of the chromatic thread, and he regards the chromosomes themselves as permanent elements of the cell nucleus. He explains in detail what is meant by "reduction-divisions," whereby the number of chromosomes in the sexual cells becomes reduced to one-half that characteristic of the nuclei of the body cells of the animal or plant. This reduction is dependent on the circumstance that the paternal and maternal chromosomes, which at sexual fusion are contributed to the fertilised ovum, remain distinct in the nucleus of that and the succeeding cells which originate from it. But at some period in the life-cycle certain cells, all or some of the descendants of which are destined to give rise again to sexual elements, exhibit two well-marked nuclear divisions that follow rapidly upon each other. In this way a definite phase (termed by some writers the *maiotic* phase) is intercalated in the cellular life-cycle of the organism, and it marks the transition from the cells with "unreduced" to those in which the nuclei possess the "reduced" number of chromosomes.

The essential feature connected with the *maiotic* phase lies in the manner in which the reduction in the number of the chromosomes is effected. Instead of a distribution to each nucleus of respective moieties of every chromosome taking place, as in the ordinary nuclear divisions, *entire* chromosomes first become temporarily united in pairs, and then the two members of each pair diverge from each other, and, aggregating into two groups, give rise to two nuclei each of which thus respectively contains half the whole complement of chromosomes present in the original nucleus.

There is some divergence of opinion as to the exact method by which the association and subsequent distribution of the chromosomes is effected during the *maiotic* phase, and perhaps it may vary somewhat in different organisms, but there is a general agreement as to the final result.

There exists a considerable weight of evidence tending to prove that the different chromosomes are responsible for different characters or groups of characters in the organism as a whole, and this circumstance is to be correlated with the fact that an equal number of these bodies is normally furnished to the fertilised ovum by each parent. Each chromosome, therefore, which is derived from the one parent will have its homologue or duplicate originating from the other. The importance of this becomes manifest when the facts of reduction are considered in relation to the behaviour of hybrids or crosses, in which a given character or group of characters (*allelomorphs* of Bateson) differs in the two parents. When such